

Keynote Address Delivered by Dr. Peter Gleick¹

Preparing for Sea Level Rise in the Bay Area: A Local Government Forum Oakland MetroCenter April 16, 2008

“Socioeconomic Impacts of Sea Level Rise in the Bay Area and Addressing Environmental Justice”

My thanks to Joe, Bruce, Trav, BCDC, and everyone else responsible for putting together this important forum today. I will address the socioeconomic impacts of a rising sea for the San Francisco Bay Area, looking at the history of what we know, and at some new research underway.

History of Efforts to Understand, and Prepare for Sea Level Rise (SEA-LEVEL RISE). Philip Williams and Associates, Ltd. (PWA) did some of the earliest work ever on SEA-LEVEL RISE in the San Francisco Bay, and in the Delta, in the late 1970s. Even at that point, there was enough evidence that climate change would raise sea level to merit some analysis of risks and responses.

The first comprehensive assessment was the research study done by the Pacific Institute with support of the Stockholm Environment Institute, released in 1990. “Assessing the Costs of Adapting to Sea Level Rise: A Case Study of San Francisco Bay” by Peter Gleick and Ed Maurer.

I will offer the major conclusions from the Pacific Institute study, and then move forward to today, and what new directions and efforts are needed.

Conclusions from 1990. The good news is that the conclusions are still remarkably robust. The bad news is that 18 years has elapsed and we’ve hardly progressed in taking action. The sea is 1 to 2 inches higher already.

Sea-level rise will inundate developed and natural areas, accelerate coastal erosion, cause salinity contamination of groundwater aquifers and rivers, damage port facilities and threaten transportation infrastructure, erode recreational beaches, and disrupt wetlands and natural habitats.

In our 1990 study, we evaluated the scientific state-of-the-art: estimates of sea-level rise at that time ranged from a low of about 0.5 meters to a high of over 3 meters. Our assessment was based on inundation from a one-meter rise.

- One of the most startling conclusions at the time was that a sea-level rise of only 15 centimeters (5.9 inches) will change the frequency of the 1-in-100 year storm into a 1-in-10 year storm at the entrance to the Bay. We had not been thinking much about the implications of sea-level rise on storm frequency. This increase will occur long before sea level rises one meter.
- The cost of protecting against sea-level rise is large, but often below the value of the property protected. Defensive actions taken early can prevent large damages in the future.

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- The value of property threatened by sea-level rise in San Francisco Bay is extremely high because of past development. In 1990, we roughly estimated that existing commercial, residential, and industrial structures threatened by a one-meter sea-level rise were valued at \$48 billion (in 1990 dollars), excluding many things, such as transportation infrastructure.
- The cost of protecting that development by building new defenses or modifying existing protection around San Francisco Bay would approach a \$1 billion (in 1990 dollars), not including the costs of protecting or restoring wetlands, or the need for any active structures such as pumps, drainage systems, and navigation locks. These costs could exceed an additional \$1 billion dollars. The costs of maintenance for these defenses are also not included and could approach \$100 million per year (again, in 1990 dollars). Where will this money come from?
- We concluded that it was unlikely that the status quo around the Bay can be maintained under conditions of expected sea-level rise, even with extensive efforts to build protective structures. Indeed, implementing all of the measures evaluated in the report would, by themselves, change the character of the Bay.
- Loss of some of the remaining natural wetlands in San Francisco Bay appears inevitable. In particular, large tracts of wetlands in the northern stretches of the Bay will be impossible to maintain in their present form, and intertidal wetland habitat in the southern stretches of the Bay may be lost entirely. Options include providing some artificial protection, which converts natural ecosystems into partially managed ecosystems; trying to restore wetlands on adjacent, higher, undeveloped land; or abandoning existing wetlands to try to adapt through natural processes.
- Deterioration of groundwater quality in some basins around the Bay will accelerate as sea level rises. No way to prevent this deterioration, other than by preventing sea-level rise, was identified.
- Sufficient money or political consensus is unlikely to be made available to protect all resources on the margins of the Bay before damaging storm events occur. As a result, difficult decisions about what to move or abandon will have to be made, and damages from flooding will increase.

Important point. Many of the socio-economic impacts of sea-level rise are not yet adequately quantified; some of the impacts of sea-level rise may never be quantifiable. These include the societal changes needed for coastal response, the unpredictable chemical and biological changes in the Bay, the social costs of migration away from affected areas, the psychological pressures of living behind coastal protection in threatened areas, and the value of lost or altered ecosystem services. Even the straight economic costs of inundation, flooding, damage are not so straightforward to estimate. What will the Bay look like in 2050, or 2100, even without sea-level rise?

Recommendations from 1990 Report

- The cheapest option to protect against future sea-level rise is to prohibit development in regions that are likely to be subjected to the greater future risk of flooding.
- Future development should be prohibited on natural lands immediately upslope of or adjacent to existing wetlands. These buffer lands may be the only areas to which present wetlands can slowly migrate, and future wetlands restoration projects will require this land.

- All present activities to construct, maintain, or modify any structure likely to be affected by sea level rise should assume a future increase in that level. The cost of modifying these structures in the design stage is considerably below the costs of both later reconstruction and flood-damage from unanticipated storm surges. Modification in the design stage can include either the capacity to accommodate higher sea levels or provisions for future retrofitting.
- Existing flood insurance programs should be modified or phased out in areas likely to be subjected to future flooding caused by sea-level rise.
- Detailed regional responses are needed. The effects of sea-level rise in one area will have spillover effects in other areas. Coordinated regional strategies will be necessary.

Where are we today? What do we know now? There is far more understanding and agreement about climate change and sea level rise, there is far more interest and concern.

Historical records show that sea level in San Francisco Bay has risen 18-20 cm (7 - 8 inches) over the past 150 years.

The Intergovernmental Panel on Climate Change and the 2006 California Climate Action Team Report project that mean sea level will rise between 10 and 90 cm (4 and 36 inches) by the year 2100. This is lower than the 1 meter used in our analysis, but:

- IPCC conservatively left out any significant component of ice melting in Greenland or Antarctica.
- Sea level will continue to rise after 2100 – it isn't going to stop there.

What don't we know?

- Rates of climate change which are a function of greenhouse gas emissions, population, and international agreements
- Levels of development and risk exposure which raise issues of equity and environmental justice based on income distribution
- Impacts on storm frequency and intensity which presents a modeling question for climatology of the Pacific
- How to quantify many things; much less how to put dollar values on them.

What can we do? What things can we control?

- Greenhouse gas emissions (a little, but international and national effects dominate)
- Adaptation responses (more under our local control)
- Form and nature of development (even more)
- Rate at which we improve our knowledge (the most)

Efforts to Date. Individual agency efforts are underway to inventory greenhouse gases and mitigation strategies, in order to develop approaches for local governments to consider.

New sea-level rise maps are available from BCDC, and a new impetus from them to really tackle this issue.

The effort underway at the Pacific Institute to re-do the economic vulnerability assessment with new tools and new information, and to expand that effort to the coast of California as a whole in collaboration with CEC, MTC, CalTrans, BCDC, Ocean Protection Council and others.

The Bay Area Regional Agency Climate Protection Program plan, an effort of the Joint Policy Committee (ABAG, BAAQMD, BCDC, MTC), has many recommendations. There are 73 in Land Use/Transportation. There are 54 in the Adaptation section. I like recommendation #26 in the Adaptation section: "Be really tough about building close to sea level."

Implementation will be key, and more difficult than making recommendations. Many important objectives, including: preparing to adapt and breaking old habits. But also, a recommendation added at the very end of the process:

"That equity consequences be integral to the consideration of all climate-change adaptations and climate-protection initiatives"

Issues for the environmental justice community. First, bring communities into the discussion and find out what they care about. Participation is key. Several critical low-income communities are at risk, including West Oakland and Bay View Hunters Point.

Other environmental justice issues

- Long-term rezoning? Disparate impacts on communities along the margins of the Bay.
- Access to public spaces.
- Army base cleanup issues and contamination.
- Relocation of transportation corridors. We already see disproportionate impacts of diesel emissions, truck traffic, and the ports.
- Impacts of construction of coastal protections (truck traffic in some communities).

Concluding Remarks. The bad news is climate change and sea-level rise are real. They place new burdens and challenges on all of us. The good news is that there are things we can do.

They are going to force us to do some things we should, perhaps, have already been doing:

- Integrated planning
- Better planning under uncertainty
- Evaluation of new kinds of impacts
- Development and application of new tools for assessment

And given that sea level rise and climate change are now unavoidable, the sooner the better.